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Geotechnical challenges for establishing an Aquifer Thermal Energy Storage (ATES) in the greater Copenhagen area (Zealand, Denmark).

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Underground Thermal Energy Storage (in particular Aquifer Thermal Energy Storage, ATES) systems are a key point to guarantee the successful integration of renewable energy (e.g. solar energy and waste-to-energy) in a smart energy grid connected to the District Heating (DH). The lack of geotechnical data, the limited and poor quality of the geophysical dataset represent the main obstacle to evaluate the potential of such technologies. The available geotechnical information target the first 50m of the subsurface, i.e. shallow and cold aquifers (natural groundwater temperature around 10°C) that if used as thermal storage will limit the potential of UTES technologies while deeper aquifers (500-800mbgl) have a higher natural water temperature (around 30°C) and no risks of interfering with the drinking water reservoirs. In the greater Copenhagen area, the potential deep ATES target is the Upper Cretaceous limestones (Chalk Group), a carbonate rock consisting mainly of the remains of planktonic algae and other pelagic organisms. Figure 1 shows some of the few data available regarding the geotechnical properties of limestones in Zealand. The elastic modulus of the Copenhagen Limestone (Cenozoic part of Chalk Group) does not show a specific trend and covers a wide range from hundreds of MPa up to 50GPa, while the elastic modulus based on deep well log data presents an overall increase of the elastic modulus with depth. To overcome the present insufficient geotechnical information, a virtual deep pilot based on the shallow ATES under construction at the Bispebjerg Hospital (Copenhagen), will be used to assess the best integration between ATES and renewable energies, focusing on identifying the long term behaviour of the system based on thermo-hydro-mechanical testing. These aspects are crucial to enable exploitation of the limestone at DH temperatures (40-90°C).

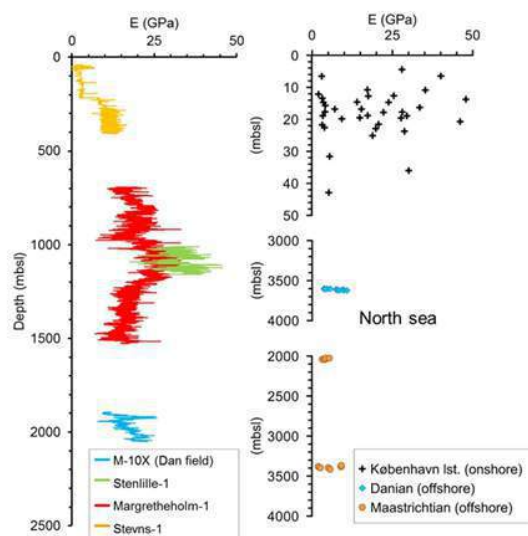


Figure 1 Elastic characteristics of Chalk Group.